DEVELOPMENT OF WEB-GIS SYSTEM FOR SHARING AND VISUALISING GEOLOGIC DATA

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ABSTRACT

The purpose of the present study is to develop an online system on Web-GIS for sharing and visualising geologic information such as borehole data, geological map and three-dimensional geologic model. The system has been constructed by integration of web mapping engine, GIS and relational database management system. The software which compose the system is the typical FOSS4G (Free and Open Source Software for Geoinformatics) products such as MapServer, GRASS GIS and PostgreSQL. The main functions of the system are management of geologic data, two and three-dimensional visualisation of geologic model and analysis of borehole data.

1. INTRODUCTION

The borehole data is utilized to understand geologic structure and physical properties in many fields such as environmental geology, disaster mitigation, and urban geological applications. To construct database for managing and sharing borehole data, a project "Development of an Integrated Geophysical and Geological Information Database" is advanced by support of Special Coordination Funds for Promoting Science and Technology of Japan Science and Technology Agency (Fujiwara *et al*., 2008).

We bear a part of the project, and are developing a Web-GIS system for sharing and visualising geologic data such as borehole data, geological map and three-dimensional geologic model (Nemoto and Kimura, 2009). The prototype system has been developed by integrating mapping engine, GIS and relational database management system into a web based client/server environment. The basic functions of the system are presented.

2. SYSTEM CONFIGURATION

The system has been successfully implemented by integrating web mapping engine, GIS and relational database management system. The software configuration of the system is shown in Table 1. Those software is FOSS (Free/Open Source Software) that can be downloaded over the Internet. An outline of the system is shown in Figure 1.

A GIS provides the core components for management, analysis and image processing of geologic data. The Geographic Resource Analysis Support System (GRASS; Byars and Clamons, 1997) was used to serve as the GIS environment. GRASS GIS was originally developed at the US Army, Construction Engineering Research Laboratory (USA-CERL, 1982-1995), but recently it is official project of the OSGeo (Open Source Geospatial Foundation, http://www.osgeo.org/). Online access to GRASS functions has been enabled using PyWPS that is an implementation of WPS (Web Processing Service).

A Relational Database Management System is used to manage metadata of geologic data. PostgreSQL which is supported under GRASS was used. The front-end for online access to database was coded using the Hypertext Preprocessor (PHP).

Table 1. Software configuration.

Software		**Download Site**
Operating System	CentOS	http://www.centos.org/
Web Server	Apache	http://www.apache.org/
Mapping Engine	MapServer	http://www.mapserver.org/
GIS	GRASS GIS	http://grass.osgeo.org/
WPS Server	PyWPS	http://pywps.wald.intevation.org/
DataBase	PostgreSQL	http://www.postgresql.org/
Spatial DB Extension	PostGIS	http://www.postgis.org/
Web-GIS Client	OpenLayers	http://www.openlayers.org/
Tool/Library	GDAL/OGR	http://www.gdal.org/

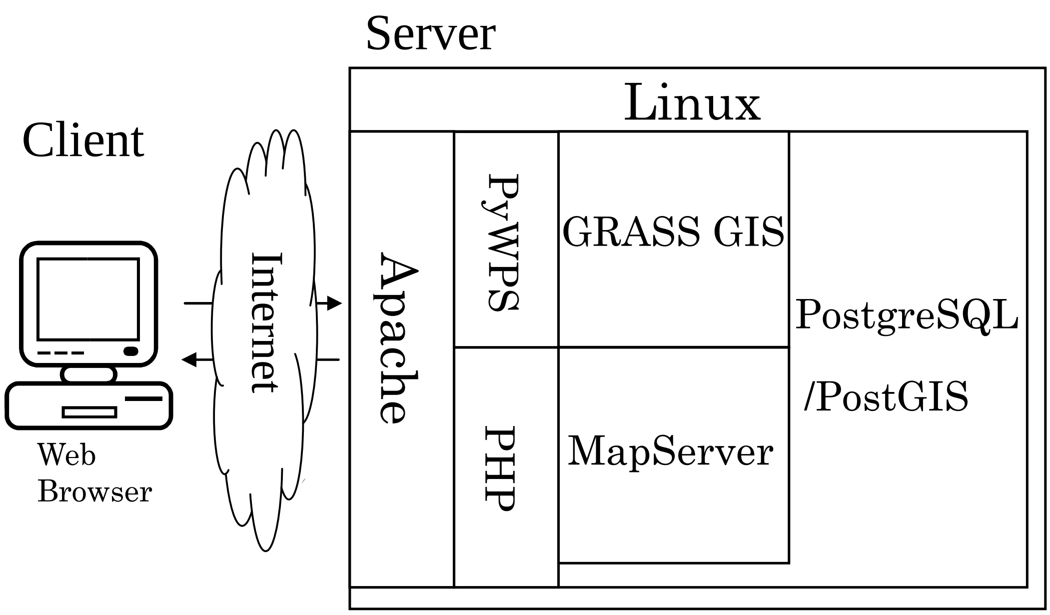

Figure 1. An outline of the system.

MapServer plays a role of mapping geologic map and horizontal section of 3-D geologic model. It is also used for WMS (Web Map Server) and WFS (Web Feature Server) of OGC (Open Geospatial Consortium, http://www.opengeospatial.org/) standards.

3. BASIC FUNCTIONS OF THE SYSTEM

The system has been developed and deployed by integrating mapping engine, GIS and relational database management system into a web based client/server environment. The main functions of the system are management of geologic data such as borehole data and 3-D geologic model, two and three-dimensional visualisation of geologic model and analysis of borehole data.

The locations of 3-D geologic model and borehole are indicated on an index map (Figure 2). Attribute information which contains URLs for two and three-dimensional visualisation of geologic model and analysis of borehole data appear by clicking the location on the map. Details of the basic functions are shown as follows;

Two-dimensional visualisation

In the two-dimensional visualisation site, the users can utilize the functions shown below;

·Map navigation allows the users to zoom-in/out, pan, and overlay layers.

·Horizontal sections of the 3-D geologic model are overlaid on the topographic map. They can be supplied via WMS. An example of horizontal section is shown in Figure 3.

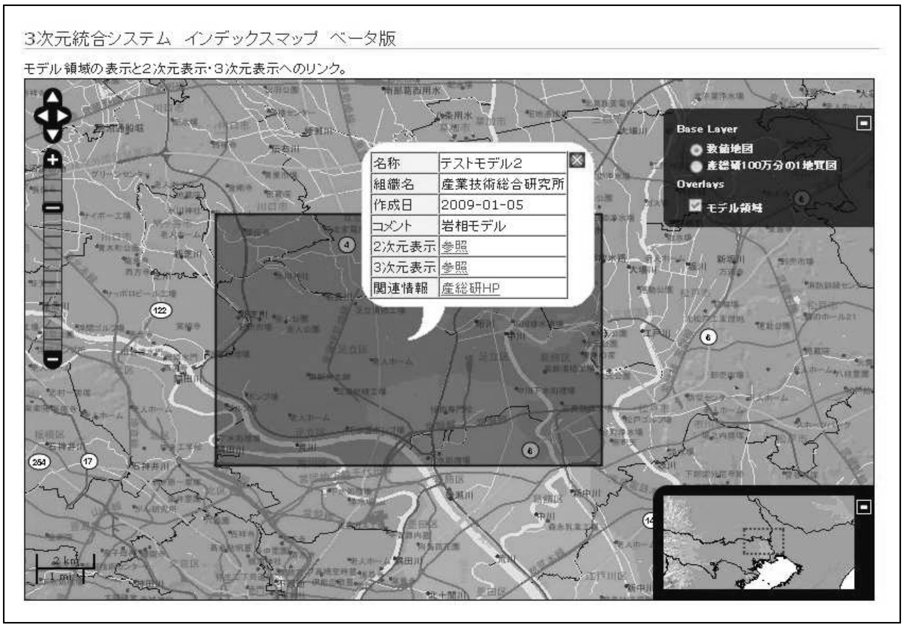

Figure 2. An index map.

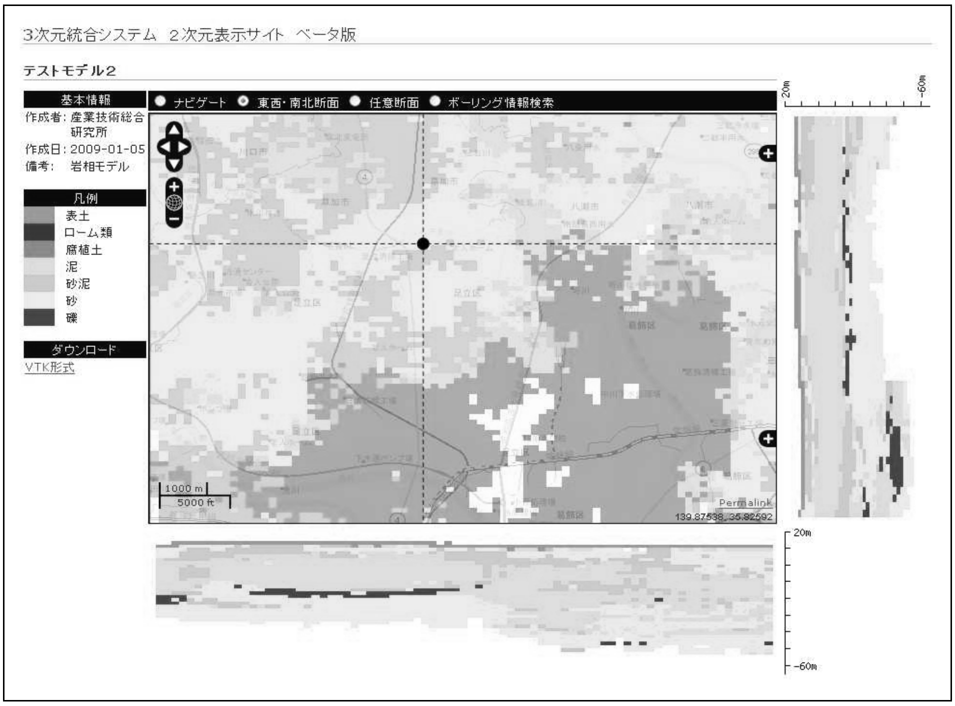

Figure 3. Horizontal section and vertical sections.

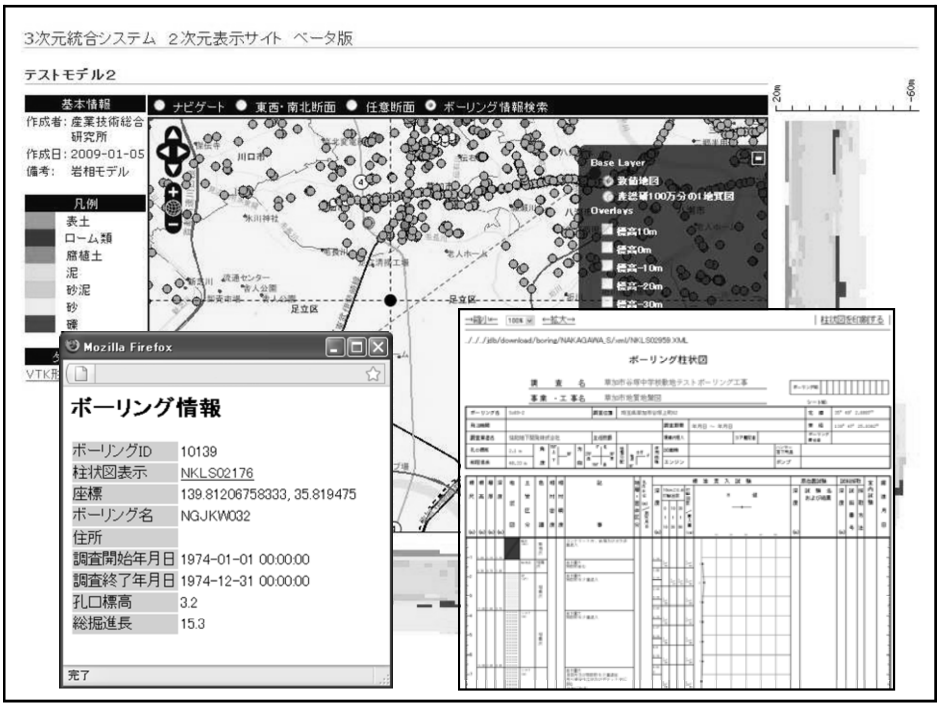

Figure 4. borehole data.

·Geologic cross sections extending east-west and north-south from a clicked point are automatically generated and displayed (Figure 3).

·A geologic cross section specified by clicking a start point and an end point is automatically generated and displayed. It can be supplied via WPS.

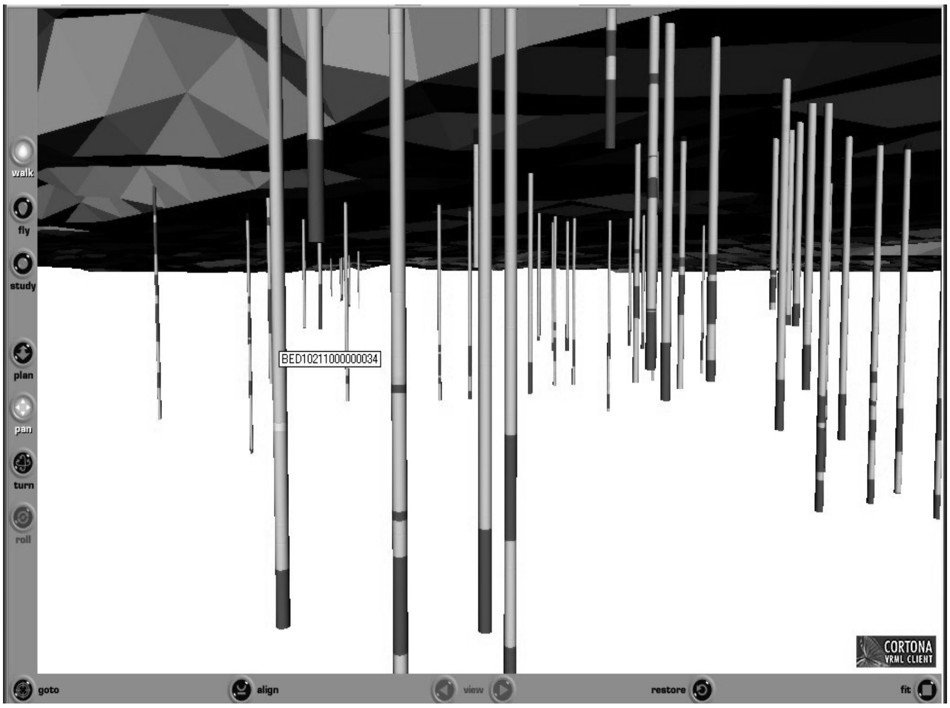

Figure 5. An example of the VRML model.

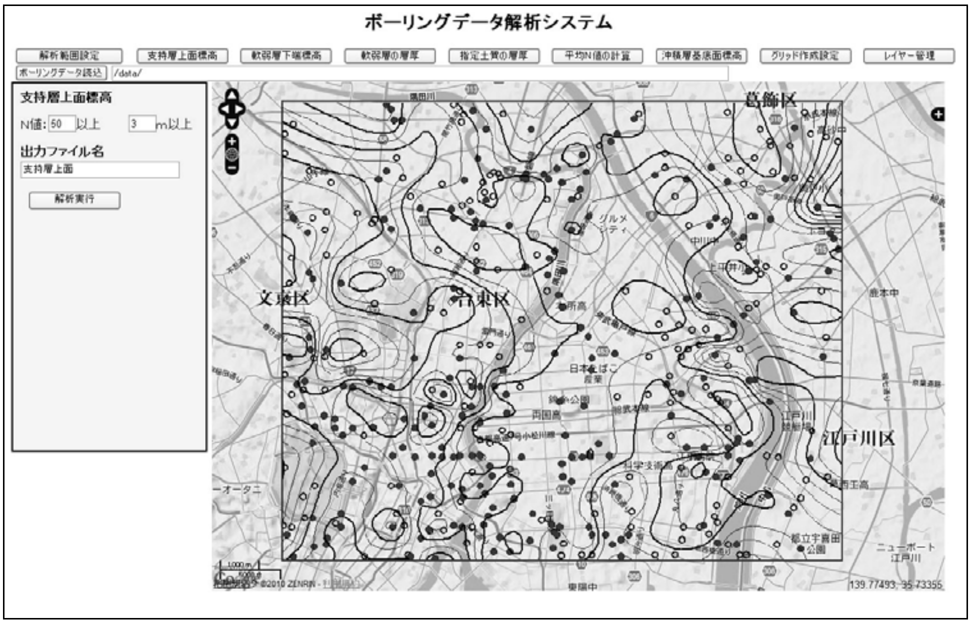

Figure 6. Result of analysis.

·A layer that shows the locations of borehole data is overlaid on the topographic map or geologic horizontal section. Attribute information of borehole data and logs are displayed by clicking a marker of it (Figure 4).

·WMS layers overlaid on the topographic map or geologic horizontal section.

Three-dimensional visualisation

In the three-dimensional visualisation site, the users can interactively navigate a VRML (Virtual Reality Modelling Language) model with geologic boundaries and borehole logs by using a VRML browser or plug-in tool. An example of the VRML model is shown in Figure 5.

Analysis of borehole data

It is possible to analyse borehole data of XML format provided by Ministry of Land, Infrastructure, Transport and Tourism of Japan. The main functions are shown below.

- The values such as an average of N-values, a thickness of soft layers, a top surface of supporting layers and a thickness of specified soil are extracted and calculated by setting some parameters.
- The values extracted from the borehole data are interpolated onto the grid by using IDW (Inverse Distance Weighted). The grid data is displayed on the map as contour lines (Figure 6).
- The data obtained as a result of the analysis can be downloaded.

4. CONCLUTIONS

We are developing a Web-GIS system for sharing and visualising geologic data such as borehole data, geological map and 3-D geologic model. The prototype of system has been successfully implemented by integrating web mapping engine, GIS and relational database management system. The main functions of the system are management of geologic data, two and three-dimensional visualisation of geologic model and analysis of borehole data. The improvement of the system will be continued.

5. ACKNOWLEDGEMENT

The present study was supported by Special Coordination Funds for Promoting Science and Technology of Japan Science and Technology Agency and Grant-in-Aid for Scientific Research by Japan Society for Promotion of Science

6. REFERENCES

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